Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at http://about.jstor.org/participate-jstor/individuals/early-journal-content.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

MECHANICS.

Conducted by B. F. FINKEL, Kidder, Missouri. All contributions to this department should be sent to him.

SOLUTIONS TO PROBLEMS.

1. **Proposed by A. M. SCRIPTURE, A. M., Principal of Schools, New Hartford, New York.**

Suppose A and B to start at the same time from the same point in a level plane. A walks south, going 30 inches at a step, stepping twice in a second and beating a drum at the beginning of each step. B steps west 30 inches every time he hears the drum beat. How far apart will they be at the end of 15 minutes, if the temperature of the air is $+41^\circ$ Fahrenheit?

Solution by Professor G. B. M. ZERR, A. M., Principal of High School, Staunton, Virginia.

The man who hears the drum beat always hears it at the extremity of the hypotenuse of an isosceles right triangle.

The length of the first hypotenuse is $\frac{30\sqrt{2}}{12}=\frac{5\sqrt{2}}{2}$ feet, of the second $\frac{60\sqrt{2}}{12}=\frac{10\sqrt{2}}{2}$ feet, of the third $\frac{15\sqrt{2}}{2}$ feet, and so on. Let a be the number of feet sound travels per second. Then $\frac{1}{2}+\frac{5\sqrt{2}}{2a}$ = the number of seconds from first beat till he hears the second beat;

$\frac{2}{2}+\frac{10\sqrt{2}}{2a}$ from the first till he hears the third beat;

$\frac{3}{2}+\frac{15\sqrt{2}}{2a}$ from the first till he hears the fourth beat;

$n\left(\frac{1}{2}+\frac{5\sqrt{2}}{2a}\right)$ from the first till he hears the $(n+1)$th beat.

But $\frac{n}{60}\left(\frac{1}{2}+\frac{5\sqrt{2}}{2a}\right)=15$ or $n=\frac{1800a}{a+5\sqrt{2}}$. $41^\circ F=\frac{5}{9}(41-32)=5^\circ C$. Velocity of sound at $0C^\circ$ and 760 mm. pressure = 1090, hence velocity at $5C$ and 760 mm. pressure $=1090\sqrt{\frac{273+5}{273}}=1099.81$ feet.

$\therefore a=1099.81$ feet. $\therefore n=1780.5$.

$\therefore$ he takes 1781 steps plus the first step $=1782$.

$1782\times2\frac{1}{2}$ feet $=4455$ feet $=B$'s distance from starting point.

$1800\times2\frac{1}{2}$ feet $=4500$ feet $=A$'s distance from starting point.

$d=$ distance apart $=\sqrt{(4455)^2+(4500)^2}=6332.22$ feet.

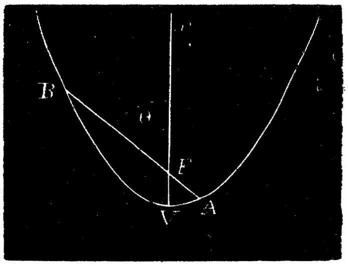
[*Professor H. C. Whitaker* gets 6355.06 feet.]

2. **Proposed by WILLIAM SYMMONDS, A. M., Professor of Mathematics and Astronomy, Pacific College, Santa Rosa, California.**

The axis of a parabola coincides with a vertical line. What is the position of that focal chord through which a body would roll down in the least time?

I. Solution by ALFRED HUME, C. E., D. Sc., Professor of Mathematics, University of Mississippi, University P. O., Mississippi.

Let AB be a focal chord of the parabola AVB, making an angle θ with Vx, the vertical axis. If $2p$ is the latus rectum of the parabola, its polar equation is $r=\frac{p}{1-\cos\theta}$.



Then $FB=\frac{p}{1-\cos\theta}$, $FA=\frac{p}{1+\cos\theta}$,

$$AB=FB+FA=\frac{2p}{1-\cos^2\theta}=\frac{2p}{\sin^2\theta}.$$

If t be the time of descent and g the acceleration due to gravity,

$$\frac{2p}{\sin^2\theta}=\tfrac{1}{2}g\cos\theta t^2,\quad\text{and}\quad t=\sqrt{\frac{4p}{g}}\cdot\frac{1}{\sin\theta\sqrt{\cos\theta}}.$$

Equating to zero the first derivative of t with regard to θ and solving the resulting equation, $2\cos^2\theta-\sin^2\theta=0$, $\sin\theta=\sqrt{\frac{2}{3}}$, or $\theta=\tan^{-1}\sqrt{2}$, and this, evidently, is the value of θ for the *minimum* value of t.

II. Solution by WILLIAM SYMMONDS, A. M., Professor of Mathematics and Astronomy, Pacific College, Santa Rosa, California.

Take 1st the two central curves with the transverse axes vertical. Let θ be the angle required. From the polar equations,

$$\text{the focal chord } l=\begin{cases}\dfrac{2a(1-e^2)}{1-e^2\cos^2\theta} & \text{in the ellipse,}\\[2ex] \dfrac{2a(e^2-1}{1-e^2\cos^2\theta} & \text{in the hyperbola.}\end{cases}$$

If t be the time required for the body to roll through l,

$$\text{then } t^2=\frac{2l}{g\cos\theta}=\begin{cases}\dfrac{4a}{g}\cdot\dfrac{1-e^2}{\cos\theta-e^2\cos^3\theta} & \text{in the ellipse,}\\[2ex] \dfrac{4a}{g}\cdot\dfrac{e^2-1}{\cos\theta-e^2\cos^3\theta} & \text{in the hyperbola.}\end{cases}$$

$$\therefore\ t\frac{dt}{d\theta}=\begin{cases}\dfrac{2a(1-e^2)}{g}\cdot\dfrac{\sin\theta-3e^2\cos^2\theta\sin\theta}{(\cos\theta-e^2\cos^3\theta)^2} & \text{in the ellipse,}\\[2ex] \dfrac{2a(e^2-1)}{g}\cdot\dfrac{\sin\theta-3e^2\cos^2\theta\sin\theta}{(\cos\theta-e^2\cos^3\theta)^2} & \text{in the hyperbola.}\end{cases}$$

In order that t should be a minimum, $\sin\theta-3e^2\cos^2\theta\sin\theta=0$ in both curves. $\therefore\ \cos^2\theta=\frac{1}{3e^2}$, $\sin^2\theta=\frac{3e^2-1}{3e^2}$. Making $e=1$,

in the parabola, $\theta=\sin^{-1}\sqrt{\frac{2}{3}}=54^\circ\ 44'\ 8''$ required.

[NOTE.— (1) Making $e>1$, any value assigned will give possible values for θ in the hyperbola. If e becomes indefinitely great θ approaches a right angle. (2) Making $e<1$ for all values of $e>\sqrt{\frac{1}{3}}$ and <1, θ is some possible angle. When $e=\sqrt{\frac{1}{3}}$, the focal chord required, coincides with the transverse axis. For all values when $e<\sqrt{\frac{1}{3}}$ $\sin\theta$ is imaginary, $\cos\theta$ takes impossible values.

Hence, in this case, θ has no value and the transverse axis must be taken as the only focal chord satisfying the conditions required.]